

## **SUPPLEMENTAL MATERIAL**

### **Expanded Methods**

#### *Search strategy and selection criteria*

Observational cohort studies eligible for inclusion were identified through an independent literature search of the Medline, Scopus and Embase databases by two researchers (AHK, LP). The complete search algorithm used in Medline is available in the Supplement. The last literature search was performed until October 28, 2020. No language restriction or other filters were used in the literature search. Reference lists of all included articles were subsequently screened to identify potential studies missed by the initial literature search. Any disagreements were resolved after discussion with a third author (GT). All case reports, non-consecutive case series, and surveys were excluded from further consideration. We also excluded studies with overlapping patient data and studies not providing the predefined outcomes of interest in relevance to the emergence of the COVID-19 pandemic. Screening of abstracts and key conference proceedings from the International Stroke Conference 2020 did not uncover any additional studies.

#### *Secondary outcomes*

We also assessed for differences according to the time of hospital admission (stroke patients admitted during the COVID-19 pandemic regional outbreak compared to historical controls) for the following secondary outcomes of interest: 1. demographics (age, sex), 2. vascular risk factors, 3. baseline stroke severity (assessed with the National Institute of Health Stroke Scale [NIHSS] score, a scale used to objectively quantify the impairment caused by a stroke with range of scores ranging from 0 to 42 points), 4. presence of large vessel occlusion in baseline vascular imaging, 5. mean time from stroke onset to hospital presentation (onset-to-door time), 6. length of total hospital stay and 7. in-hospital all-cause mortality. Data extraction for patient characteristics and outcomes of interest was performed independently by the two researchers that performed the literature search (AHK, LP).

### Complete search algorithm used in MEDLINE search

(((((("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]) OR "coronaviruses"[All Fields]) OR "COVID"[All Fields]) OR (((((((("covid 19"[All Fields] OR "covid 2019"[All Fields]) OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept]) OR "severe acute respiratory syndrome coronavirus 2"[All Fields]) OR "2019 ncov"[All Fields]) OR "sars cov 2"[All Fields]) OR "2019ncov"[All Fields]) OR (("wuhan"[All Fields] AND ("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields]))))) OR ("severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[All Fields]) OR (("severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[All Fields]) OR "sars cov 2"[All Fields]) AND (((((((("stroke"[MeSH Terms] OR "strokes"[All Fields]) OR "stroke"[All Fields]) OR (((("cerebrovascular disorders"[MeSH Terms] OR ("cerebrovascular"[All Fields] AND "disorders"[All Fields])) OR "cerebrovascular disorders"[All Fields]) OR ("cerebrovascular"[All Fields] AND "disease"[All Fields])) OR "cerebrovascular disease"[All Fields])) OR (((("intracranial haemorrhage"[All Fields] OR "intracranial hemorrhages"[MeSH Terms]) OR ("intracranial"[All Fields] AND "hemorrhages"[All Fields])) OR "intracranial hemorrhages"[All Fields]) OR ("intracranial"[All Fields] AND "hemorrhage"[All Fields])) OR "intracranial hemorrhage"[All Fields]) OR (((("intracerebral haemorrhage"[All Fields] OR "cerebral hemorrhage"[MeSH Terms]) OR ("cerebral"[All Fields] AND "hemorrhage"[All Fields])) OR "cerebral hemorrhage"[All Fields]) OR ("intracerebral"[All Fields] AND "hemorrhage"[All Fields])) OR "intracerebral hemorrhage"[All Fields]) OR (((((((("cerebrally"[All Fields] OR "cerebrum"[MeSH Terms]) OR "cerebrum"[All Fields]) OR "cerebral"[All Fields]) OR "brain"[MeSH Terms]) OR "brain"[All Fields]) AND ((("veins"[MeSH Terms] OR "veins"[All Fields]) OR "venous"[All Fields]) AND (((("sinus thrombosis, intracranial"[MeSH Terms] OR ("sinus"[All Fields] AND "thrombosis"[All Fields]) AND "intracranial"[All Fields])) OR "intracranial sinus thrombosis"[All Fields]) OR ("sinus"[All Fields] AND "thrombosis"[All Fields])) OR "sinus thrombosis"[All Fields])))) OR (((("subarachnoid haemorrhage"[All Fields] OR "subarachnoid hemorrhage"[MeSH Terms]) OR ("subarachnoid"[All Fields] AND "hemorrhage"[All Fields])) OR "subarachnoid hemorrhage"[All Fields]))

**Supplemental Table I.** Table of excluded studies with reasons for exclusion

<b>Study Name</b>	<b>Reason(s) for exclusion</b>
Baracchini et al [1]	Not providing data on the outcomes of interest
Bres Bullrich et al [2]	Not providing data on the outcomes of interest
Butt et al [3]	Not providing data on the outcomes of interest
Hajdu et al [4]	Not providing data on the outcomes of interest
Hsiao et al [5]	Not providing data on the outcomes of interest
de Havenon et al [6]	Not providing data on the outcomes of interest
Dowlathshahi et al [7]	Not providing data on the outcomes of interest
Diegoli et al [8]	Not providing data on the outcomes of interest
Gittins et al [9]	Not providing data on the outcomes of interest
Majidi et al [10]	No control group available
Morelli et al [11]	Not providing data on the outcomes of interest
Onteddu et al [12]	Overlapping data with other publications
Perry et al [13]	Not providing data on the outcomes of interest
Sacco et al [14]	Not providing data on the outcomes of interest
Schwarz et al [15]	Not providing data on the outcomes of interest
Tejada Meza et al [16]	Overlapping data with other publications

**Supplemental Table II.** Overview of included studies

Study name	Study location	Population	Pandemic outbreak period	Pre-pandemic period	N patients
Agarwal et al [17]	New York	stroke admissions	01 Mar 2020 - 15 May 2020	01 Jun 2019 - 29 Feb 2020	754
Altschul et al [18]	Bronx, New York	LVO admissions	1 Mar - 17 Apr 2020	1 Jan - 17 Feb 2020	80
Benussi et al [19]	Brescia, Lombardy, Italy	stroke admissions	21 Feb - 30 Apr 2020	1 Jan 2010 - 20 Feb 2020	6324
Briard et al [20]	Montreal	stroke admissions	30 Mar - 31 May 2020	(2019)	294
Chen et al [21]	Taiwan	stroke admissions	Jan-Mar 2020	(2019)	7734
Cummings et al [22]	South Carolina	stroke admissions	Mar-Apr 2020	Mar 2019-Feb 2020	5852
Desai et al [23]	Pittsburgh	stroke admissions	Mar 2020	Mar 2019, Mar 2018, Mar 2017	257
Esenwa et al [24]	New York	stroke admissions	25 Feb - 17 Apr 2020	1 Jan - 25 Feb 2020	423
Frisullo et al [25]	Italy	stroke admissions	11 Mar - 11 Apr 2020	(2019)	93
Ghanchi et al [26]	Colton, California	stroke admissions	Jan - Apr 2020	(2019)	262
Huang et al [27]	USA (telemedicine)	stroke admissions	11 Mar - 9 Apr 2020	10 Feb - 10 Mar 2020	213
Jasne et al [28]	Connecticut	stroke admissions	Mar - Apr 2020	Feb 2020	378
John et al [29]	UAE	stroke admissions	1 Mar - 10 May 2020	(2019)	358
Katsanos et al [30]	Central South Ontario	Reperfusion therapies	17 Mar - 30 Apr 2020	1 Mar 2019 - 16 Mar 2020	281
Katsouras et al [31]	Greece	stroke admissions	2 Mar - 12 Apr 2020	(2019)	106
Kerleroux et al [32]	France	LVO patients	15 Feb - 30 Mar 2020	(2019)	1512
Kristoffersen et al [33]	Norway	stroke admissions	13 Mar - 30 Apr 2020	3 Jan - 12 Mar 2020	323
Mehrpour et al [34]	Teheran, Iran	stroke admissions	15 Feb - 15 Apr 2020	(2020)	81
Montaner et al [35]	Seville	stroke admissions	15 Mar - 31 Mar 2020	15 Jan - 15 Mar 2020	102
Naccarato et al [36]	Trieste, Italy	stroke admissions	9 Mar - 9 Apr 2020	(2019)	45
Nagamine et al [37]	California	stroke admissions	Mar - Apr 2020	(2019)	112
Nguyen-Huynh et al [38]	Northern California	stroke admissions	15 Mar 20 - 9 May 2020	1 Jan 2019 - 14 Mar 2020	3837
Ohara et al [39]	Kobe, Japan	stroke admissions	1 Mar- 23 May 2020	3 Mar - 25 May 2019	1775

Padmanabhan et al [40]	UK	stroke admissions	15 Mar - 14 Apr 2020	(2019)	268
Paliwal et al [41]	Singapore	stroke admissions	7 Feb - 30 Apr 2020	1 Nov 2019 - 7 Feb 2020	350
Pandey et al [42]	Michigan & northwest Ohio	stroke admissions	March 2020	(Mar 2019)	1150
Plumereau et al [43]	Lyon	reperfusion therapies	29 Feb - 10 May 2020	(2019)	577
Pop et al [44]	Alsace, France	stroke admissions	1-31 Mar 2020	(2019)	462
Rinkel et al [45]	Amsterdam	stroke admissions	16 Mar - 3 May 2020	21 Oct - 8 Dec 2019	716
Roushdy et al [46]	Egypt	stroke admissions	15 Feb 2020 +/- 50 days	historical	244
Rudilosso et al [47]	Barcelona	stroke admissions	1 - 31 Mar 2020	(2019)	191
Sarfo et al [48]	Ghana	stroke admissions	Jan-Jun 2020	historical (2019)	832
Schirmer et al [49]	USA	stroke admissions	Mar 2020	Feb 2020	390
Seiffert et al [50]	Germany	stroke admissions	Jan - May 2020	Jan - May 2019	30515
Sharma et al [51]	US	stroke admissions	23 Mar - 19 Apr 2020	25 Mar-21 Apr 2019	665
Siegler et al [52]	New Jersey	stroke admissions	1 Mar - 15 Apr 2020	1 Oct 2019 - 29 Feb 2020	328
Sweid et al [53]	Pennsylvania, USA	stroke admissions	15 Mar - 30 Apr 2020	(2017-2019)	161
Tejada Meza et al [54]	northwest Spain	reperfusion therapies	14 Mar - 3 May 2020	30 Dec 2019 - 14 Mar 2020	796
Teo et al [55]	Hong Kong	stroke admissions	23 Jan - 24 Mar 2020	(2019)	162
Tulius Silva et al [56]	Rio de Janeiro, Brazil	stroke admissions	Mar - May 2020	(2019)	70
Uchino et al [57]	Ohio, USA	stroke alerts	9 Mar - 2 Apr 2020	1 Jan - 8 Mar 2020)	902
Wang et al [58]	Virginia	stroke admissions	12 Mar - 30 Jun 2020	1 Dec 2019 - 11 Mar 2020	575
Yang et al [59]	Beijing	EVT treated patients	23 Jan -7 Mar 2020	1 Dec 2019 - 14 Jan 2020	55
Zhao et al [60]	China	Stroke admissions	Feb 20	(2019)	56306
Zhou et al [61]	Wuhan	IVT treated patients	1 Jan - 30 Mar 2020	(2019)	2297
Zini et al [62]	Bologna, Italy	Stroke admissions	1 Mar - 30 Apr 2020	(2019)	283

USA: United States of America, UAE: United Arab Emirates, LVO: large vessel occlusion, EVT: endovascular thrombectomy, IVT: intravenous thrombolysis

**Supplemental Table III.** Quality assessment of included studies with the Newcastle–Ottawa Scale

Study name	Selection	Comparability	Outcome	Overall score
Agarwal et al [17]	****	*	***	8
Altschul et al [18]	***	**	***	8
Benussi et al [19]	****	**	***	9
Briard et al [20]	****	*	***	8
Chen et al [21]	****	**	***	9
Cummings et al [22]	****	*	***	8
Desai et al [23]	****	*	**	7
Esenwa et al [24]	****	*	***	8
Frisullo et al [25]	****	**	**	8
Ghanchi et al [26]	****	*	***	8
Huang et al [27]	***	**	***	8
Jasne et al [28]	****	**	**	8
John et al [29]	****	**	***	9
Katsanos et al [30]	****	**	***	9
Katsouras et al [31]	****	*	***	8
Kerleroux et al [32]	***	**	***	8
Kristoffersen et al [33]	****	*	**	7
Mehrpour et al [34]	****	*	***	8
Montaner et al [35]	****	**	***	9
Naccarato et al [36]	****	**	**	8
Nagamine et al [37]	****	**	***	9
Nguyen-Huynh et al [38]	****	*	***	8
Ohara et al [39]	****	*	***	8
Padmanabhan et al [40]	****	**	**	8

Paliwal et al [41]	*****	**	***	9
Pandey et al [42]	*****	*	**	7
Plumereau et al [43]	***	**	***	8
Pop et al [44]	*****	**	**	8
Rinkel et al [45]	*****	**	***	9
Roushdy et al [46]	**	**	**	6
Rudilosso et al [47]	*****	**	***	8
Sarfo et al [48]	*****	*	***	8
Schirmer et al [49]	*****	*	**	7
Seiffert M et al [50]	*****	*	***	8
Sharma M, et al [51]	*****	*	**	7
Siegler JE, et al [52]	*****	**	***	9
Sweid A et al [53]	*****	*	***	8
Tejada Meza et al [54]	*****	*	***	8
Teo et al [55]	*****	**	***	9
Tulius Silva M et al [56]	*****	**	***	9
Uchino et al [57]	*****	**	**	8
Wang et al [58]	*****	**	***	9
Yang et al [59]	***	**	***	8
Zhao et al [60]	*****	*	**	7
Zhou et al [61]	***	**	***	8
Zini et al [62]	*****	**	***	9
<b>Overall Score</b>	<b>176/184</b>	<b>73/92</b>	<b>125/138</b>	<b>373/414</b>

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**Supplemental Table IV.** Overall admission and daily admission rates before and during the pandemic

<b>Study name</b>	<b>N patients pandemic</b>	<b>Pandemic Daily admission rate*</b>	<b>N patients pre-pandemic</b>	<b>Pre-pandemic Daily admission rate*</b>
Agarwal et al [17]	120	1.6	634	2.3
Esenwa et al [24]	153	2.9	270	4.8
Huang et al [27]	71	2.4	142	4.7
Kristoffersen et al [33]	105	2.1	218	3.0
Nguyen-Huynh et al [38]	363	6.6	3474	7.9
Ohara et al [39]	813	9.8	962	11.6
Paliwal et al [41]	144	1.7	206	2.1
Rinkel et al [45]	309	6.4	407	8.5
Sharma et al [51]	274	10.1	391	14.5
Siegler et al [52]	53	1.2	275	1.8
Wang et al [58]	255	2.5	320	3.1

\*mean number of stroke patients admitted per day



## Supplemental References

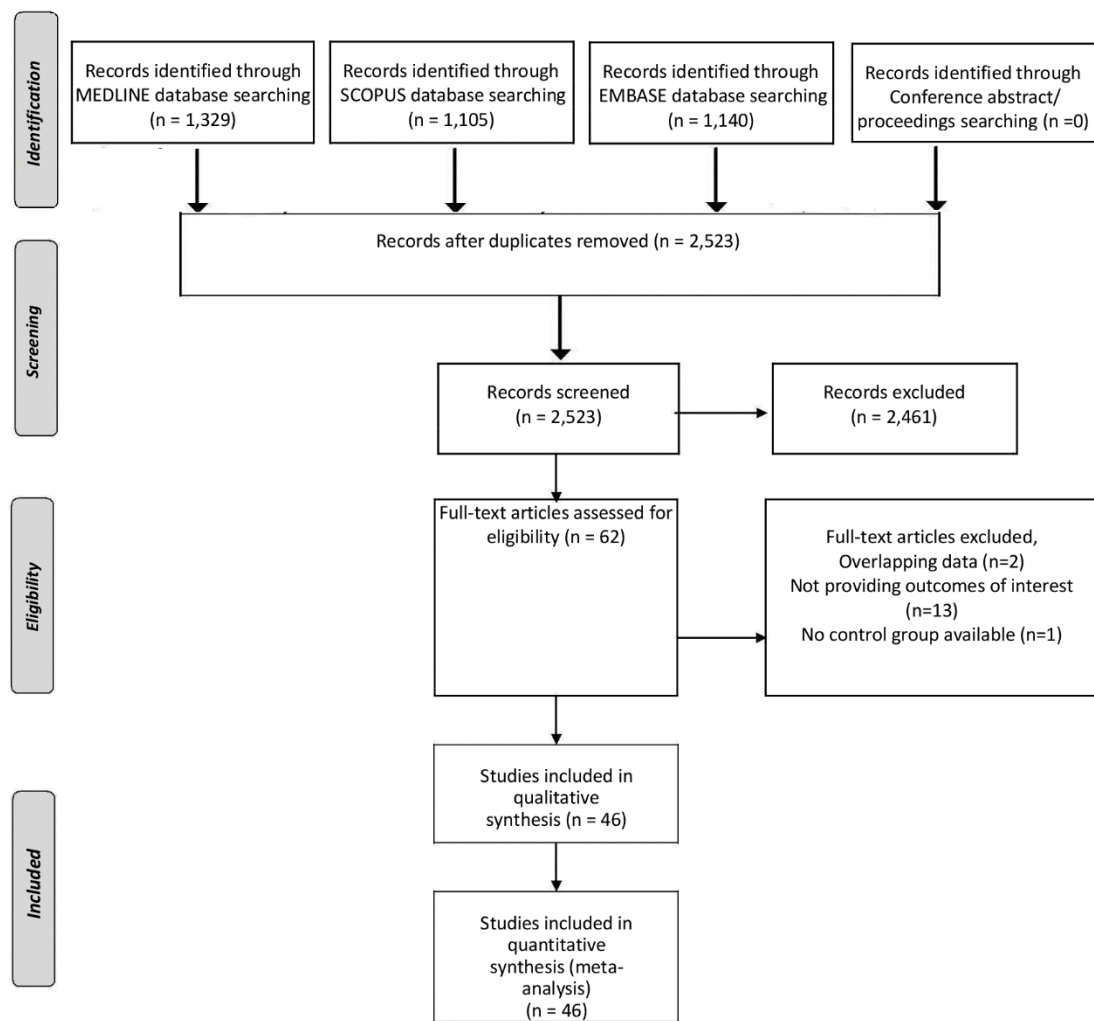
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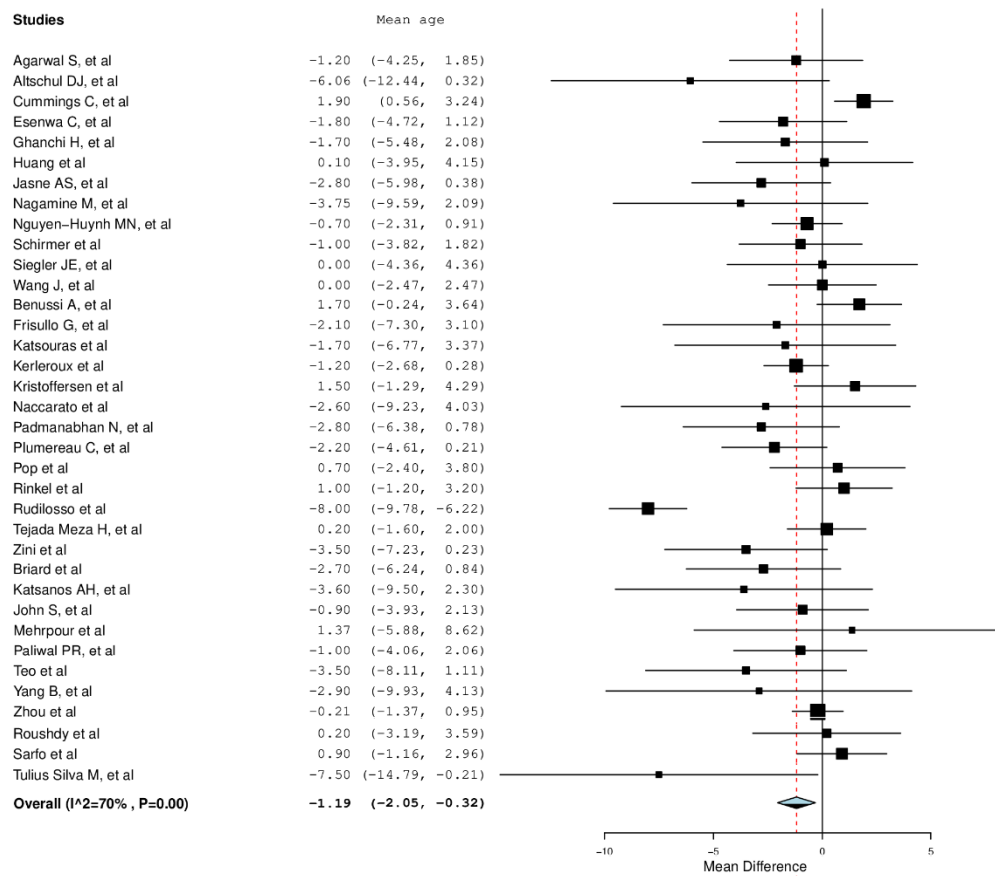
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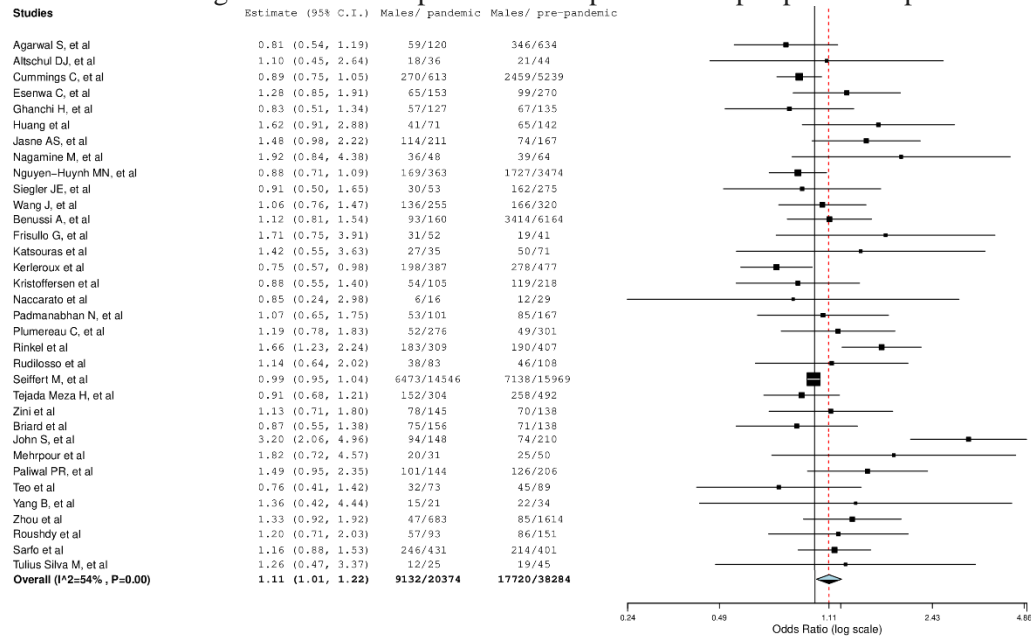
**Supplemental Figure I.** PRISMA flow diagram presenting the selection of eligible studies



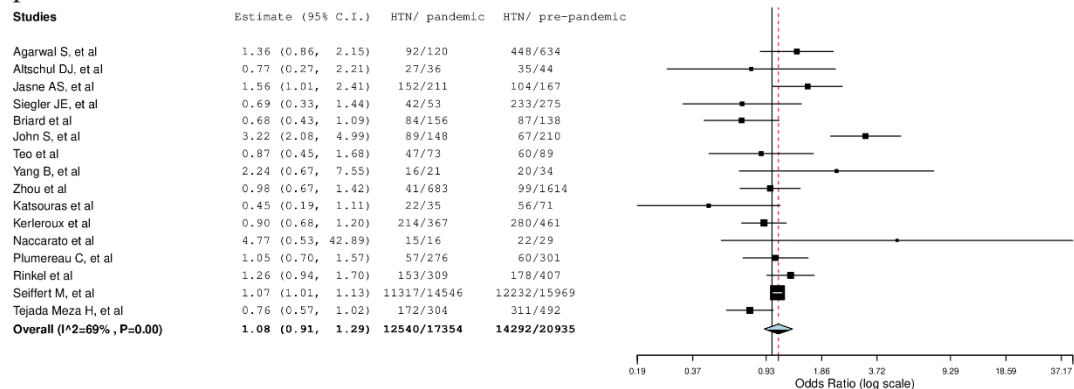
**Supplemental Figure II.** Pooled analysis on the mean age difference of patients admitted with stroke during the COVID-19 pandemic outbreak compared to the pre-pandemic period.



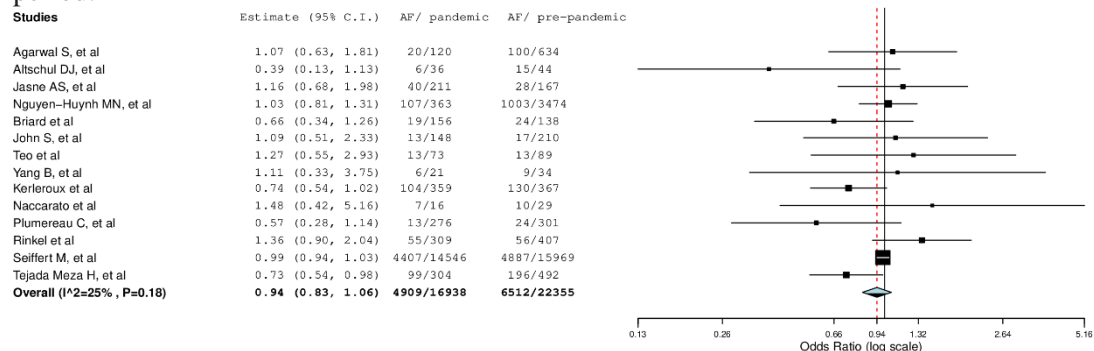
### Supplemental Figure III. Pooled analysis on the probability of male patients being admitted with stroke during the COVID-19 pandemic compared to the pre-pandemic period.



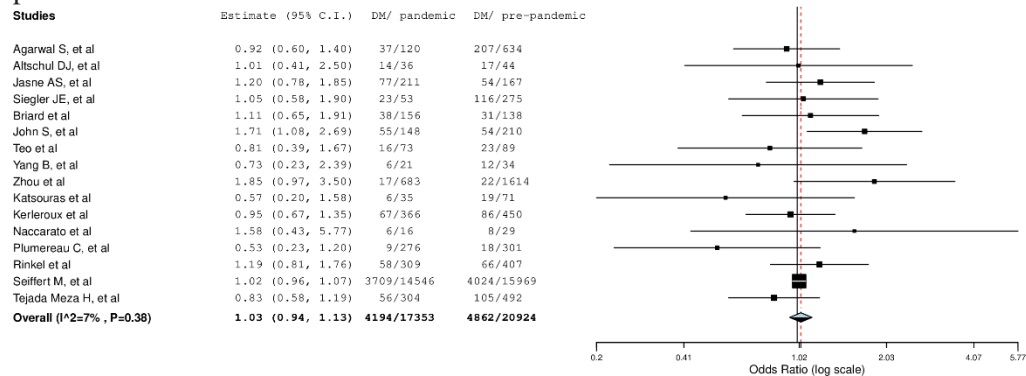
### Supplemental Figure IV. Pooled analysis on the probability of hypertension prevalence among stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.



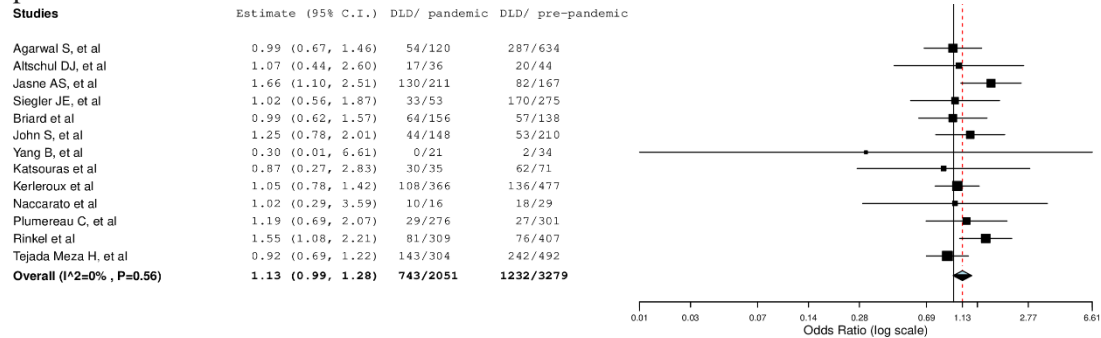
### Supplemental Figure V. Pooled analysis on the probability of atrial fibrillation prevalence among stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.



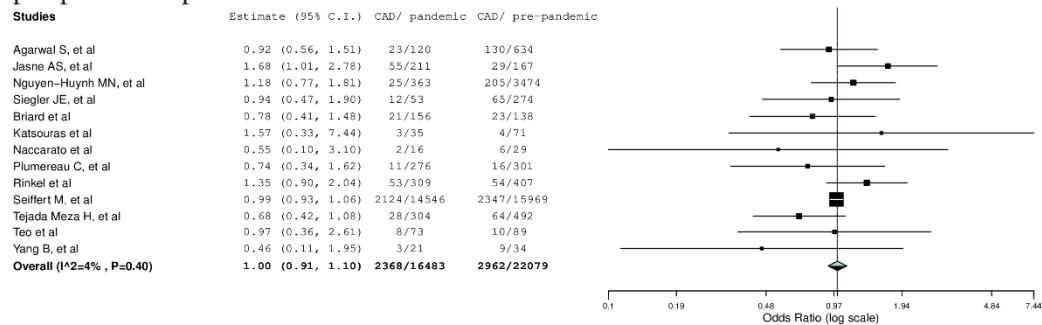
## Supplemental Figure VI. Pooled analysis on the probability of diabetes mellitus prevalence among stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.



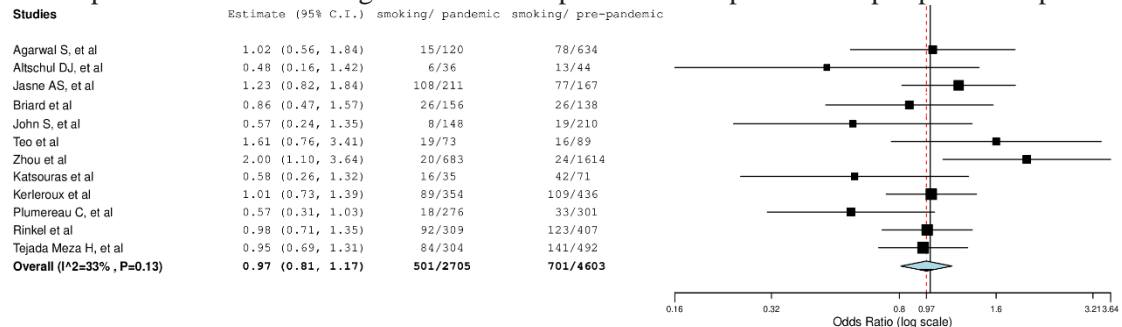
## Supplemental Figure VII. Pooled analysis on the probability of dyslipidemia prevalence among stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.



## Supplemental Figure VIII. Pooled analysis on the probability of coronary artery disease prevalence among stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.

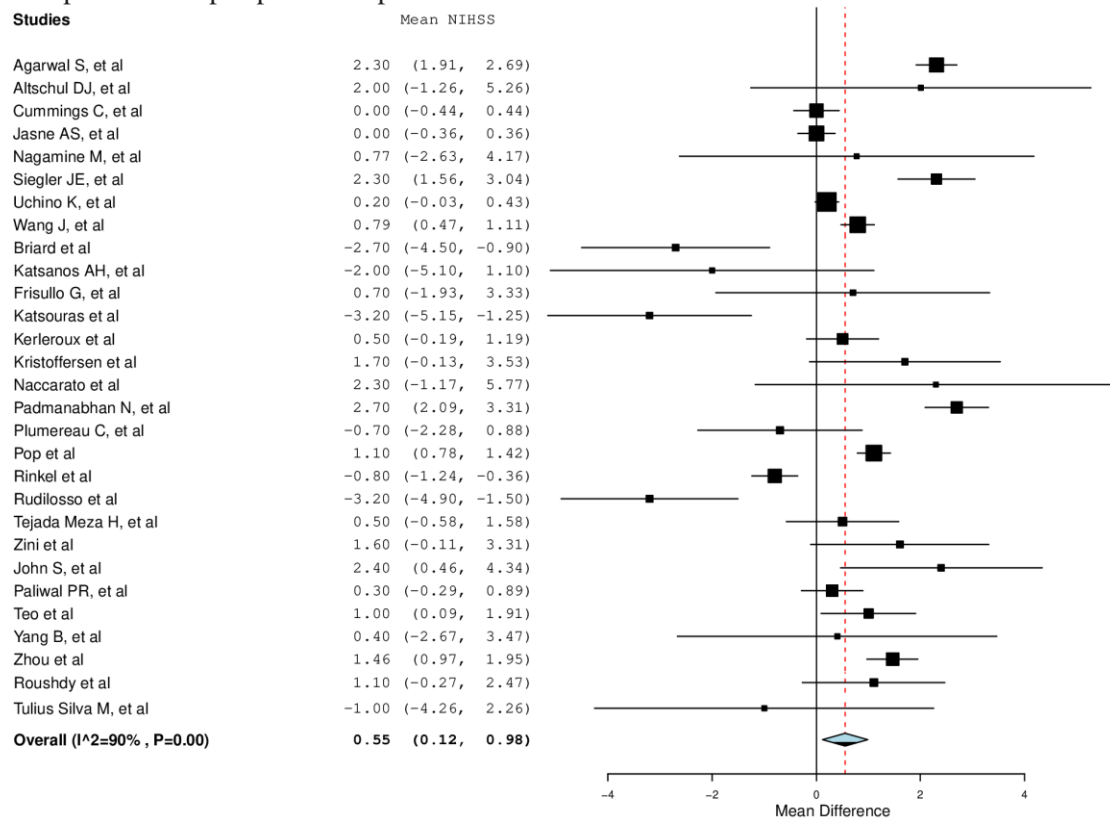


## Supplemental Figure IX. Pooled analysis on the probability of smoking prevalence among stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.

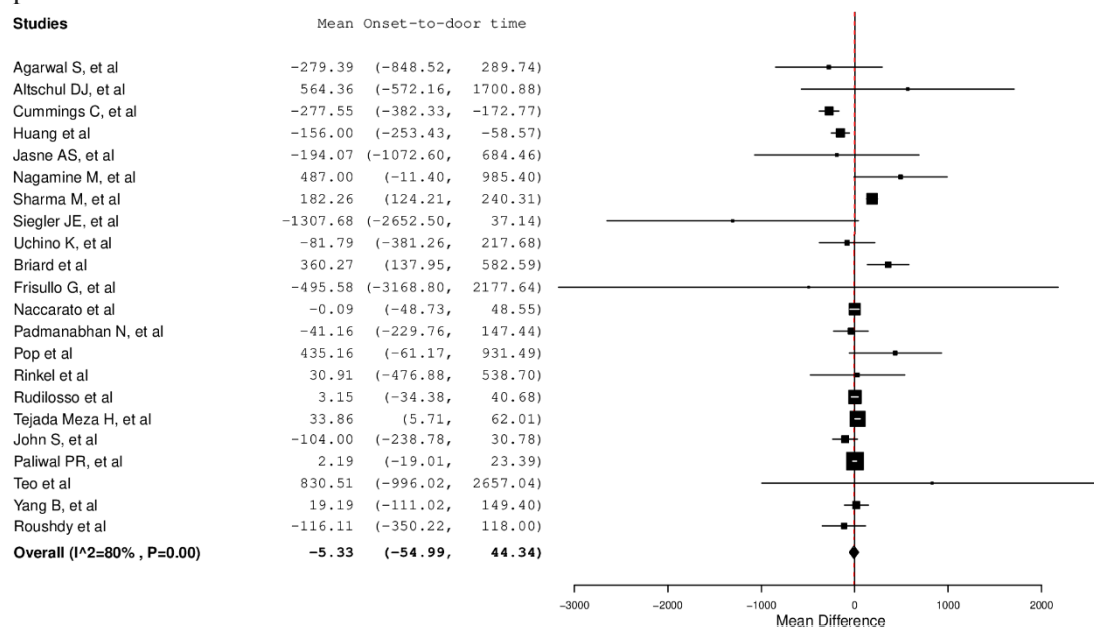




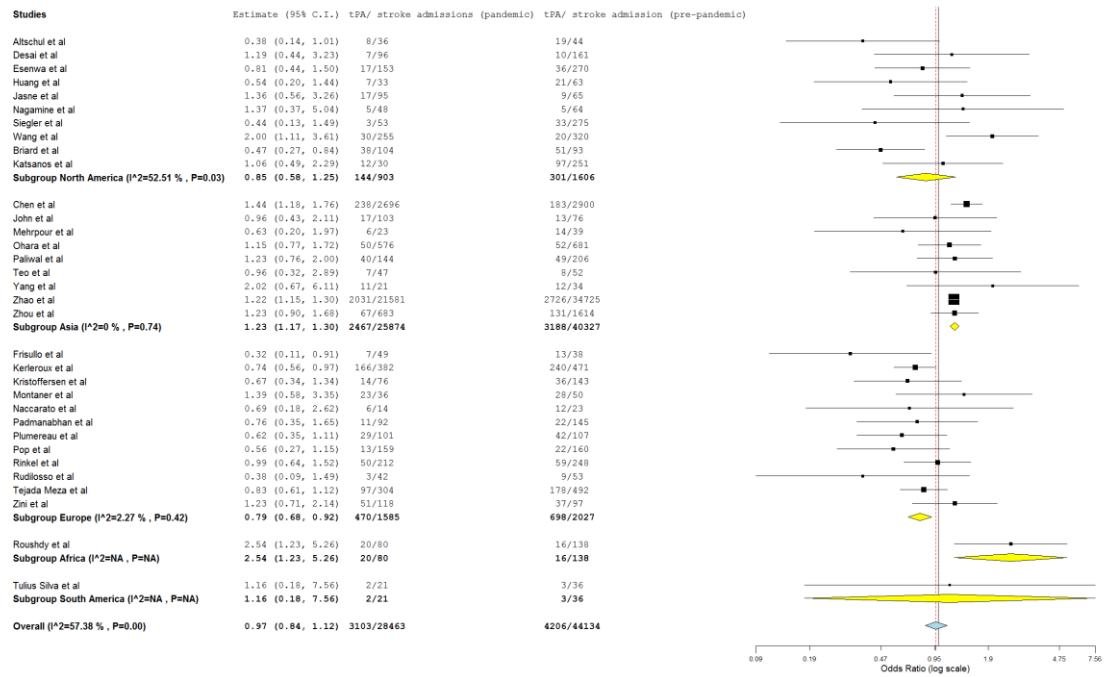
**Supplemental Figure X.** Pooled analysis on the mean National Institutes of Health Stroke Scale (NIHSS) difference of patients admitted with stroke during the COVID-19 pandemic compared to the pre-pandemic period.



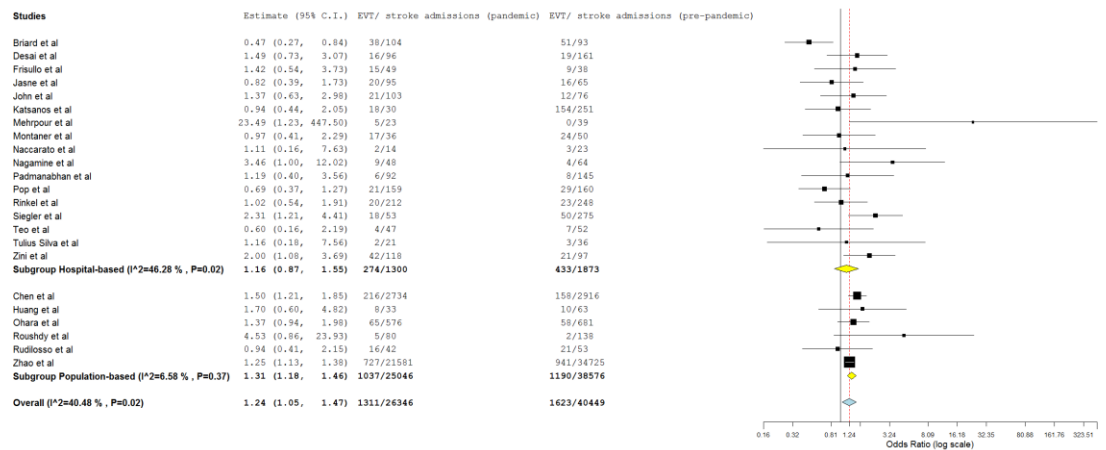
**Supplemental Figure XI.** Pooled analysis on the mean onset-to-door time difference of patients admitted with stroke during the COVID-19 pandemic compared to the pre-pandemic period.



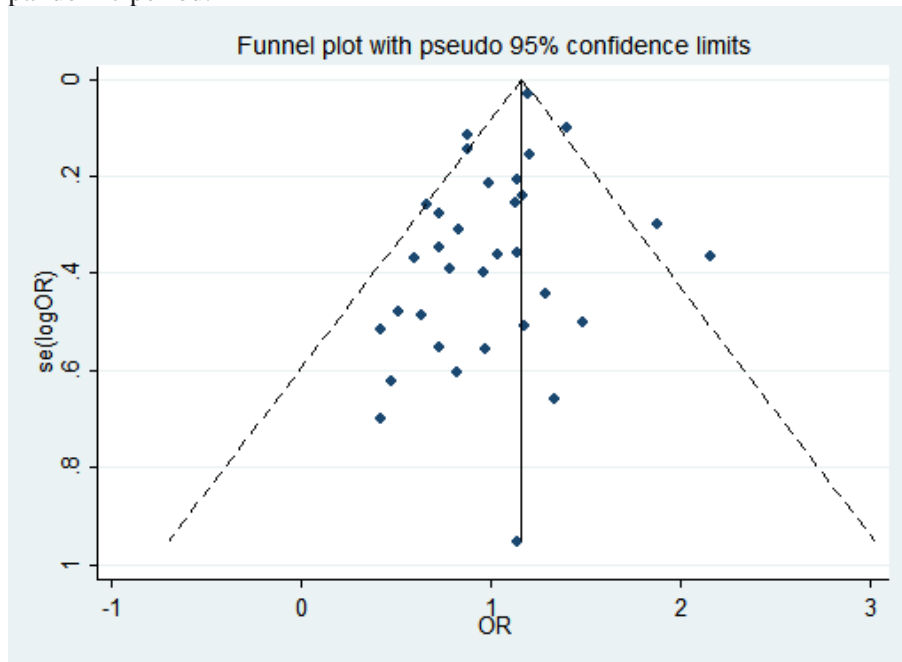
**Supplemental Figure XII.** Pooled analysis on the probability of intravenous thrombolysis treatment administration among ischemic stroke patients admitted during the COVID-19 pandemic compared to the pre-pandemic period.



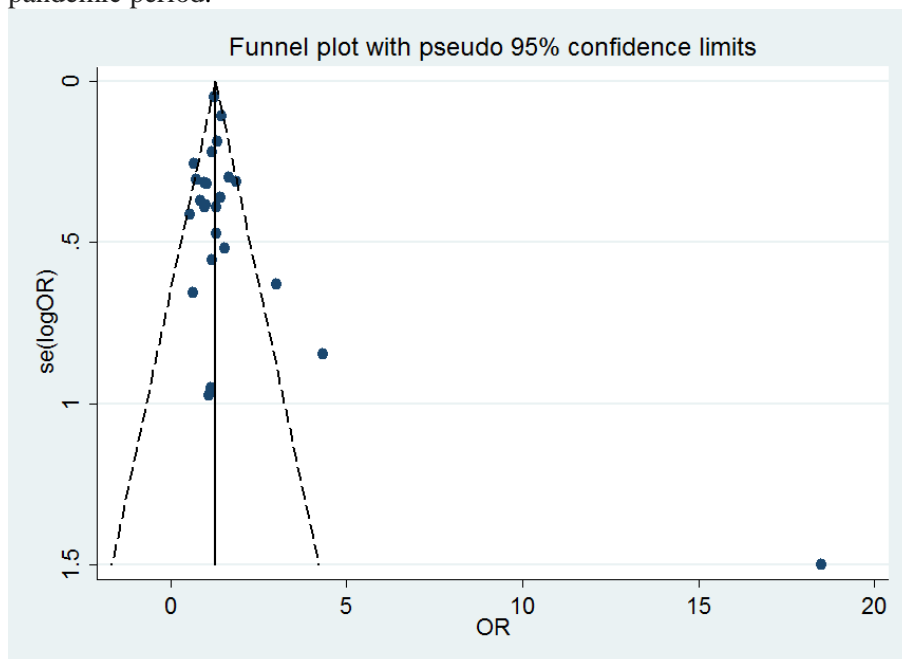
**Supplemental Figure XIII.** Pooled analysis on the probability of endovascular thrombectomy treatment among stroke patients admitted during the COVID-19 pandemic outbreak compared to the pre-pandemic period, dichotomized according to study type.



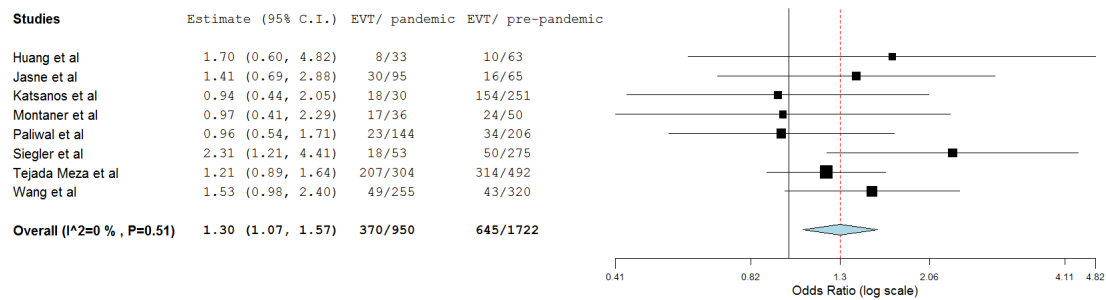
**Supplemental Figure XIV.** Funnel plot on the relative probability of ischemic stroke patients treated with intravenous thrombolysis during the COVID-19 pandemic compared to the pre-pandemic period.



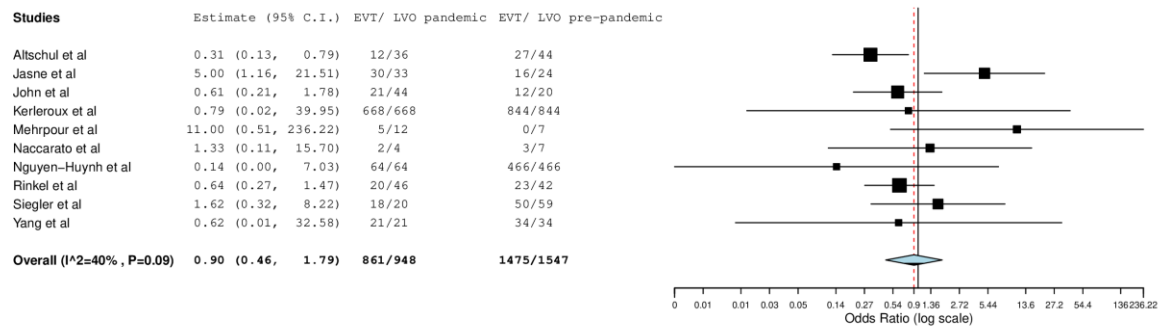
**Supplemental Figure XV.** Funnel plot on the relative probability of ischemic stroke patients treated endovascular thrombectomy during the COVID-19 pandemic compared to the pre-pandemic period.



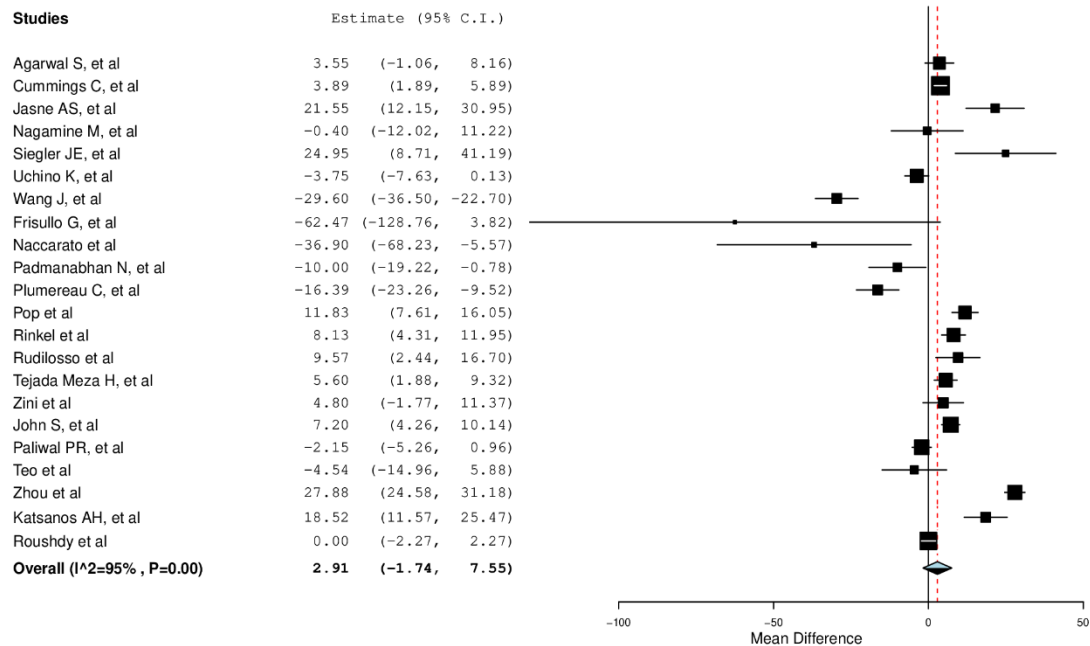
**Supplemental Figure XVI.** Sensitivity analysis on the probability of endovascular thrombectomy treatment among stroke patients admitted during the COVID-19 pandemic outbreak compared to the time periods just prior to the pandemic.



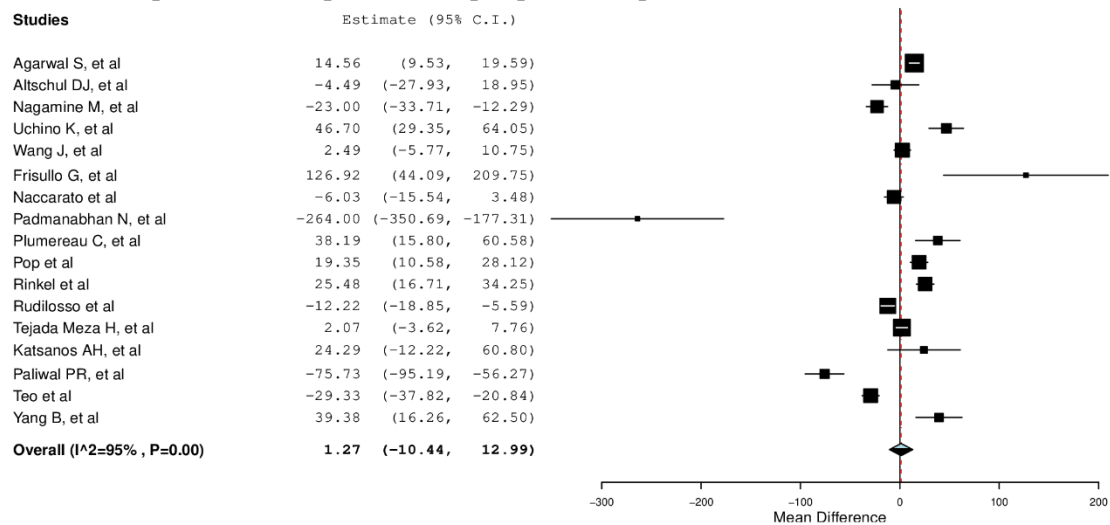
**Supplemental Figure XVII.** Pooled analysis on the probability of endovascular thrombectomy treatment among ischemic stroke patients with an acute large vessel occlusion admitted during the COVID-19 pandemic outbreak compared to the pre-pandemic period.



**Supplemental Figure XVIII.** Pooled analysis on the mean door-to-needle time difference of ischemic stroke patients treated with intravenous thrombolysis during the COVID-19 pandemic compared to the pre-pandemic period.



**Supplemental Figure XIX.** Pooled analysis on the mean door-to-groin puncture time difference of ischemic stroke patients treated with endovascular thrombectomy during the COVID-19 pandemic compared to the pre-pandemic period.



**Supplemental Figure XX.** Pooled analysis on the mean length of hospital stay difference of patients admitted with stroke during the COVID-19 pandemic compared to the pre-pandemic period.

